

## Chapter II: Range Characteristics & Activities to Consider When Implementing Best Management Practices (BMP)

### 2.0 Background

Since each firing range site is unique, BMPs for lead must be selected to meet site-specific conditions in order to achieve maximum success. A range's physical characteristics and the operational aspects (e.g., volume of shooting, shooting patterns and operating schedules) will effect which BMPs may apply and how they will be implemented. Accordingly, whether designing a new outdoor range or operating an existing range, it is important that BMPs incorporate techniques appropriate for the range's individual characteristics.

Section 2.1 of this chapter identifies the physical characteristics that must be considered when evaluating your range. A summary of common physical characteristics at ranges is also presented in Table 2-1. These factors include:

- Range Size (primarily for shotgun ranges)
- Soil Characteristics
- Topography/Runoff Direction
- Annual Precipitation
- Ground and Surface Water
- Vegetation
- Accessibility

Section 2.2 discusses the operational aspects that must be considered. These factors include:

- Lead Volume
- Size of Shot/Bullets
- Operating Schedule
- Shooting Direction and Pattern
- Range Life Expectancy

In addition, Section 2.3 discusses issues that are specific to implementing BMPs when planning a new range.

### 2.1 Physical Characteristics

Physical characteristics of ranges, relative to lead management issues, are discussed below.

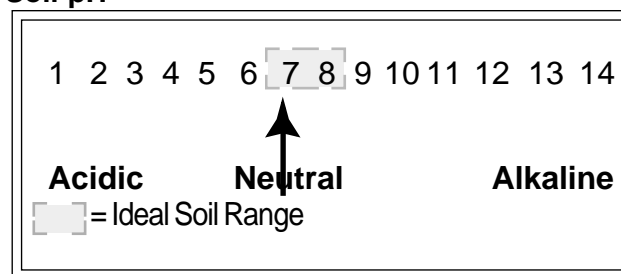
#### Range Size

Shotgun range design and type affects the ease of lead shot collection. Larger ranges typically tend to have lead shot that is dispersed over a wider area, while smaller ranges tend to concentrate lead shot in a smaller area. Reducing the area of the shotfall zone will concentrate the shot within a smaller area, allowing for easier cleanup and reclamation. BMP techniques for reducing the shotfall zone at trap and skeet ranges, as well as sporting clay ranges, are discussed in Chapter III.

#### Soil Characteristics

Spent lead bullets and shot are most often deposited directly on and into soil during shooting. When lead is exposed to air and water, it may oxidize and form one of several compounds. The specific compounds created, and their rate of migration, are greatly influenced by soil characteristics, such as pH and soil types. **Knowing the soil characteristics of an existing range site is a key component to developing an effective lead management plan.**

#### Soil pH



**Figure 2-1 – pH scale**

Soil acidity is measured as pH on a scale (illustrated as Figure 2-1) between 1 (most acidic) and 14 (most alkaline, or basic), where 7 is termed neutral. Ideal soil pH for shooting ranges is 6.5 to 8.5.<sup>1</sup>

<sup>1</sup> National Shooting Sports Foundation, "Environmental Aspects of Construction and Management of Outdoor Shooting Ranges," June 1997.

Lead reacts more readily and may become more mobile under acidic (pH < 6) or higher alkaline (pH>8) conditions. This means that spent lead shot left in or on such soils may eventually break down and contaminate underlying soil. In moderately alkaline soils (pH 7 - 8.5), the lead precipitates out of solution and binds to the soil. This “binding” effect prevents the lead from migrating to the subsurface. In general, soils in the eastern part of the United States tend to be acidic, whereas western soils tend to be more alkaline.

### Soil Physical Characteristics

The migration rate of specific lead compounds is affected by the physical characteristics of soil. For example, dense soils, consisting of heavy clays, will prevent the lead compound from moving quickly through the subsurface. Any “free” lead ions become attached to clay particles, with this bond helping to prevent migration. However, with denser soils, the amount of surface runoff increases.

Although clay soils inhibit migration, lead reclamation by contemporary removal machinery tends to be more difficult in clayey conditions. Clayey soils tend to clog the screens and “bind” with shot and bullets. This situation may require additional traditional screening, or perhaps screening using water to enhance separation.

In contrast, sandy soils or gravel may not impede migration because the open pores of these soils allow lead compounds to percolate quickly. Fortunately, lead reclamation activities are more easily conducted in sandy soils. With this in mind, ranges located in sandy soils should remove lead more frequently.

### Annual Precipitation

One of the most important factors that influences lead degradation (i.e., chemical reactions) and migration is precipitation. Water, most often in the form of rain, provides the means by which lead is transported. In general, ranges located in areas with high annual/seasonal rainfall<sup>2</sup> have a higher risk of lead migration than those located in

arid regions. This is especially true of outdoor ranges using “Steel Bullet Traps.”

Steel bullet traps build up a layer of lead residue; these particles are extremely small and more easily transported by rain/water. Also, the smaller the particle, the quicker it will degrade. A bullet trap needs to have a means to collect contact water, or be covered to prevent water from reaching it, and to minimize releases and degradation.

### Topography/Runoff Directions

The topography of your range impacts both the ease of lead reclamation and the mobility of the lead. For example, lead reclamation is more successful at ranges where the shotfall zone is relatively flat, since many lead reclamation companies use heavy machinery that cannot operate on slopes or steep hills.

Another important characteristic is the direction in which your range topography slopes. During and after periods of rain, stormwater runoff may wash lead particles or lead compounds off the range. If there are surface water bodies such as lakes, rivers, or wetlands downgradient, the potential for lead to adversely affect the surrounding environment is even greater. Therefore, it is important to identify and control the direction of surface water runoff at your range. BMPs for modifying and controlling runoff are described in detail in Chapter III.

### Groundwater

**Groundwater depth should be considered when developing a lead management plan since the closer the groundwater is to the surface, the greater the potential for dissolved lead to reach it.**

### Vegetation

**Vegetative ground covers can impact the mobility of lead and lead compounds.**

Vegetation absorbs rainwater, thereby reducing

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2 Heavy annual rainfall is anything in excess of the average annual rainfall, which for the northeast United States (e.g. New York, New Jersey) is between 40 and 45 inches.

**Table 2-1 – Common Physical Characteristics at Ranges – Potential Risks and Benefits Associated with Range Operations**

<b>Physical Characteristics</b>	<b>Potential Risk to Environment</b>	<b>Potential Benefits in Preventing/Managing Contamination</b>
Clay, acidic soils	Acidic soils contribute to lead dissolution -- increasing the potential for lead contamination -- may increase run-off Difficult to reclaim lead via sifting/raking	May impede percolation of water through contaminated soil Binds "free" lead ions May benefit growth of vegetative covers
Sandy, alkaline soils	Contaminated rainwater can easily percolate through soil groundwater  Extremely alkaline soil will not support vegetation	Alkaline soils may inhibit lead dissolution  Easier to reclaim lead via sifting/raking
Sandy, acidic soils	Acidic soils contribute to lead dissolution -- increasing the potential for lead contamination  Contaminated rainwater percolates quickly through sandy soils	Easier to reclaim lead via sifting/raking
Steep Rolling Terrain	May promote off-site drainage or drainage to on-site surface water bodies  Can promote "ponding" where contaminated runoff may collect  Can impede reclamation of expended shot via raking	None
Flat Terrain	Rainwater may "pond" in areas promoting lead dissolution and contamination	Expended shot easily recovered  Off-site drainage minimized
Wooded areas	May impede lead reclamation activities making equipment difficult to maneuver  May provide habitat for wildlife - increasing exposure to lead	None
On-site or contiguous surface water bodies	VERY high potential for contamination when shot fall zone is located over or adjacent to water; increased wildlife exposure; increased lead dissolution. This is NOT an option for successful range location and may be more likely subject to litigation and/or governmental action if lead is deposited into water bodies	None
Vegetation	Lead may be absorbed into grasses, other wildlife food sources	Ground covers slow down surface water run-on and run-off  Some vegetation can extract lead ions from the soils

the time that the lead is in contact with water. Vegetation also slows down surface water runoff, preventing the lead from migrating off-site. However, excessively wooded areas (such as those often used for sporting clay ranges) inhibit lead reclamation by making the soils inaccessible to some large, lead-removal machinery. Understanding the type, concentration and variety of vegetation on your range is necessary for developing your lead management program and implementing BMPs at your range.

### Accessibility

**Accessibility to shotfall zones and backstops is extremely important for lead reclamation activities.** A range that is not accessible to reclamation equipment will have difficulty implementing lead reclamation practices.

## 2.2 Operational Aspects

Operating practices can have a great affect on the volume and dispersion of lead at your range.

### Lead Volume

**Keeping records of the number of rounds fired over time at your range is important.** The number of rounds fired provides a realistic estimate of the quantity of lead available for reclamation. This information helps to determine when reclamation is necessary in order to prevent accumulation of excess amounts of lead, thereby decreasing the potential for the lead to migrate off-site.

### Size of Shot/Bullets

**Knowledge of the size shot/bullets used on your range may be helpful.** Lead reclamation companies generally use physical screening techniques to separate lead shot and bullets from soil. These screens come in a variety of sizes. Knowing what size shot/bullets have been used at your range will allow the reclaimer to maximize the yield of lead shot/bullets at your range.

### Shooting Direction and Patterns

**Shooting directions and patterns are important to consider when determining the effectiveness of bullet containment devices.** For example, many bullet traps are effective in containing bullets fired from specific directions. It is vital that you utilize bullet containment devices that match your range's specific shooting patterns and manufacturers specifications. Understanding the shooting direction and patterns will also help to correctly identify the shotfall zone at trap and skeet ranges.

### Shooting into Water Bodies

**Shooting into water bodies or wetlands should not occur.** Besides the environmental impacts discussed previously, the introduction of lead to surface water bodies will likely cause a range to be susceptible to litigation and/or governmental action. Shooting into water bodies or wetlands is NOT an option for ranges that want to survive in the future.

### Range Life Expectancy and Closure

The life span of your range may be impacted by many factors, including financial and environmental issues, noise, and encroachment on residential areas. If your range is slated for closure, contact your local state or EPA representatives for guidance.

## 2.3 Planning a New Range

As discussed in the previous sections, site characteristics and operational aspects affect lead migration, degradation and reclamation activities at ranges. **If you are planning on opening a new range, you should select and/or design a site in consideration of the factors discussed in this manual.** This will allow you to minimize the potential of lead impacting your site or adjacent properties. A new range owner has the advantage of being able to design a successful lead management program in full consideration of the site characteristics and recommended BMPs. This advanced understanding of operational aspects

and requirements will allow you to minimize the potential for lead migration prior to opening.

**The most important site selection criteria to consider when selecting a new range location include: topography; surface water flow patterns; and depth to groundwater.** If possible, ranges should be developed on flat terrain, as it facilitates reclamation and reduces the chance of off-site migration due to surface water runoff as compared with highly sloped terrain. When considering a prospective location for a range, ask yourself: What is the direction of surface water runoff? Does the site drain to surface water (e.g., streams, rivers) on-site? Off-site? Can the range design be modified to minimize potential runoff?

**By selecting an appropriate location and designing a lead management program in consideration of site characteristics, new shooting ranges can be developed to minimize the potential for lead contamination.** Other important site characteristics can be modified. For example, a new shotgun range can be designed to concentrate the shotfall area, vegetation can be added or altered, and the most advantageous shooting direction can be selected. These modifications are BMPs, and are discussed in further detail in Chapter III.

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